Building Age should be Considered when Evaluating Apartment Building Safety*

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Abstract

My abstract

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*Code and Data are available at:https://github.com/NnnnninaW/Toronto-Apartment-Building-Evaluation.git

Introduction

Apartment building safety is essential for both landlords and tenants. The City of Toronto ensures that tenants live in safe, well-maintained buildings through RentSafeTO: Apartment Building Standards, a bylaw enforcement program established in 2017. The program covers buildings that are three or more storeys and ten or more units(Standards 2022). For Housing Safety Management, Housing safety awareness is crucial. Initiatives like evaluations along with effective audits and penalties are essential for provoking safety awareness for everyone. Moreover, it is necessary for programs operated by RentSafeTO to share informative results to the public.

However, there is no guarantee that the current evaluation criteria could capture all kinds of risks. Risk could arise because of a specific hazard—an act, event, or phenomenon—posing potential harm to people or activities or things. Fire, earthquake, wind storms, flooding, toxic and allergenic materials, and terrorist attack are examples of hazards associated with buildings(Council 1991). It is reasonable for building evaluation focusing on the aspect of risk resistance which is closely related to the building age problem. But, throughout my analysis, the evaluation program does not appear to have capabilities of detecting severe potential risks like construction damage, hazards resistance, and housing age problem. These factors are closely related to individuals not only from the perspective of real estate investment but also personal and public safety.

The remainder sections would show that it is worth paying attention of building age problem in Toronto when evaluating apartment safety since the City of Toronto has experienced rapid urbanization like Shanghai(Jin Ban 2020). Section 2 would present the process of analysis. Section 2.1 would introduce the background and overview of collected data. Section 2.2 would reveal the methods and data cleaning process. Section 2.3 would present results and findings in the analysis. Section 3 concludes our analysis with discussion of limitations. Last Section includes all software and literature materials used for this analysis.

Table 1: Summary of Score and Number of Areas Evaluated

	Mean	Standard_Deviation
SCORE	72.3500360119354	10.0612099580959
NO_OF_AREAS_EVALUATED	17.1614363617656	1.66355391952787

2 Data

2.1 Data Source

To analyze the current status of building safety evaluation in Toronto, I utilized the Apartment Building Evaluation data(Standards 2022) from Open Data Toronto (Gelfand 2020). This dataset contains building evaluation scores for buildings registered with RentSafeTO with individual scores for each criteria. The dataset also contains registered information of when the building is built and what property type it belongs to. However, this dataset does not provide historical scores for each observation which means that each score represents the most recent conducted evaluation. The dataset was last updated on February 5th,2022. Here is a summary of what should be expected as the average level for our analysis in terms of overall score and number of areas being evaluated in Table 1.

2.2 Methodology and Data Collection

Under Apartment Building Evaluation by RentSafeTO, individual criteria are inspected and assigned a score from 1 to 5, with 1 being the lowest and 5 being the highest. If an item is not applicable to the building at the time of evaluation, the score will show as blank in the dataset(Standards 2022). It is reasonable for a building to have a few unavailable examinations due to different infrastructures. Overall, we do have large enough sample size for analysis. The overall score is then determined by dividing the sum of all assigned scores of each item by 5 multiplying the number of unique items reviewed(Standards 2022).

I started my exploratory analysis by using R (R Core Team 2020), dplyr(Wickham et al. 2021), tidyverse(Wickham et al. 2019). Tables and graphs are generated using kableExtra(Zhu 2021), ggplot2(Wickham 2016), modelsummary(Arel-Bundock 2022), and estimatr(Blair et al. 2022).

After checking some basic characteristics of the original data, I changed individual score variables into numeric form for further analysis. Then, I filtered observations that should not be included since this evaluation program is for Apartment Building with three or more storey or 10 or more units to comply with building maintenance standards. Also, to study the building age problem in Toronto, I created a New Variable to show the building age when encountering the evaluation. Then, a single measurement is created or location as distance to downtown using CN Tower (latitude = 43.642567,-79.387054) as the benchmark.

According to RentSafeTO, buildings must undergo evaluation at least once every three years. If buildings score 65 per cent or less, then the next evaluation will take place within one year. If the score is between 66 – 85 per cent, the next evaluation will take place within two years and if buildings score 86 percent and above the next evaluation with be within three years(Toronto 1998 - 2022 2022). So I created a new variable that separate observations into groups by this score criteria. To see if Toronto housing really has a building age problem, I created a new variable that separate observations into groups by the building age when conducting the evaluation.

There are three types of property included: private, Toronto Community Housing Corporation (TCHC) or social housing(Standards 2022). Table 2 provides an overview of the cleaned dataset grouping by property type with changes mentioned above.

Table 2: Descriptive Statistics for Results of Evaluation Grouping by Property Types

		PRIVATE (N=8175)		SOCIAL HOUSING (N=605)		TCHC (N=939)	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
SCORE		72.4	10.1	75.3	9.1	69.6	9.4
NO_OF_AREAS_EVALUATED		17.0	1.7	17.7	1.6	18.0	1.3
ENTRANCE_LOBBY		3.7	0.8	3.7	0.7	3.4	0.7
ENTRANCE_DOORS_WINDOWS		3.6	0.7	3.7	0.7	3.4	0.6
SECURITY		4.0	0.9	4.2	0.8	3.9	0.8
STAIRWELLS		3.4	0.8	3.5	0.8	3.1	0.8
LAUNDRY_ROOMS		3.5	0.8	3.7	0.7	3.4	0.7
INTERNAL_GUARDS_HANDRAILS		3.5	0.8	3.8	0.7	3.6	0.7
GARBAGE_CHUTE_ROOMS		3.5	0.8	3.6	0.8	3.3	0.8
GARBAGE_BIN_STORAGE_AREA		3.5	0.7	3.6	0.7	3.4	0.7
ELEVATORS		3.8	0.8	3.7	0.7	3.5	0.7
STORAGE_AREAS_LOCKERS		3.5	0.7	3.8	0.7	3.4	0.7
INTERIOR_WALL_CEILING_FLOOR		3.5	0.7	3.5	0.7	3.2	0.7
INTERIOR_LIGHTING_LEVELS		3.5	0.9	3.7	0.7	3.6	0.7
GRAFFITI		4.6	0.7	4.6	0.8	4.0	1.0
EXTERIOR_CLADDING		3.5	0.7	3.8	0.6	3.4	0.7
EXTERIOR_GROUNDS		3.6	0.7	3.6	0.7	3.4	0.7
EXTERIOR_WALKWAYS		3.6	0.7	3.7	0.6	3.5	0.6
BALCONY_GUARDS		3.7	0.8	3.7	0.7	3.5	0.7
WATER_PEN_EXT_BLDG_ELEMENTS		3.6	0.7	3.8	0.7	3.5	0.7
PARKING_AREA		3.3	0.7	3.5	0.7	3.3	0.7
OTHER_FACILITIES		4.0	0.8	4.0	0.7	3.7	0.7
Building_Age_at_Evaluation		60.6	17.0	36.1	24.1	44.2	14.4
Distance_to_DT		11.5	5.3	10.2	7.0	11.3	7.0
		N	Pct.	N	Pct.	N	Pct.
Score_Group	65% or Less	1970	24.1	84	13.9	287	30.6
	66%-85%	5302	64.9	423	69.9	598	63.7
	85% or Higher	895	10.9	98	16.2	54	5.8
	NA	8	0.1	0	0.0	0	0.0
Building_Age_Group	0-30yr	162	2.0	328	54.2	154	16.4
	120+yr	45	0.6	12	2.0	0	0.0
	30-60yr	4291	52.5	202	33.4	667	71.0
	60-90yr	3093	37.8	39	6.4	111	11.8
	90-120yr	584	7.1	24	4.0	7	0.7

Data Source: Open Data Toronto

Table 3: Summary of Property Type and Score Group under RentSafeTO for Evaluation

		N	%
PROPERTY_TYPE	PRIVATE	8175	84.1
	SOCIAL HOUSING	605	6.2
	TCHC	939	9.7
Score_Group	65% or Less	2341	24.1
	66%-85%	6323	65.1
	85% or Higher	1047	10.8
	NA	8	0.1
Building_Age_Group	0-30yr	644	6.6
	120+yr	57	0.6
	30-60yr	5160	53.1
	60-90yr	3243	33.4
	90-120yr	615	6.3

2.3 Data Characteristic

First of all, we can see that most of the buildings included for the evaluations are private property from Table 3. However, in Table 2, the average number of areas evaluated is 17 which is the lowest one among three property types. This implies that the current criteria of evaluation lack of certain measurements for the majority type of the apartment buildings. This could be adjusted by modifying evaluation items to better incorporates specific factors of private buildings. In addition, Table 3 shows that approximately 90% of the buildings could not score higher than 85%. The overall condition is not satisfied for building a safe environment. Most apartment buildings need close attention of safety monitoring.

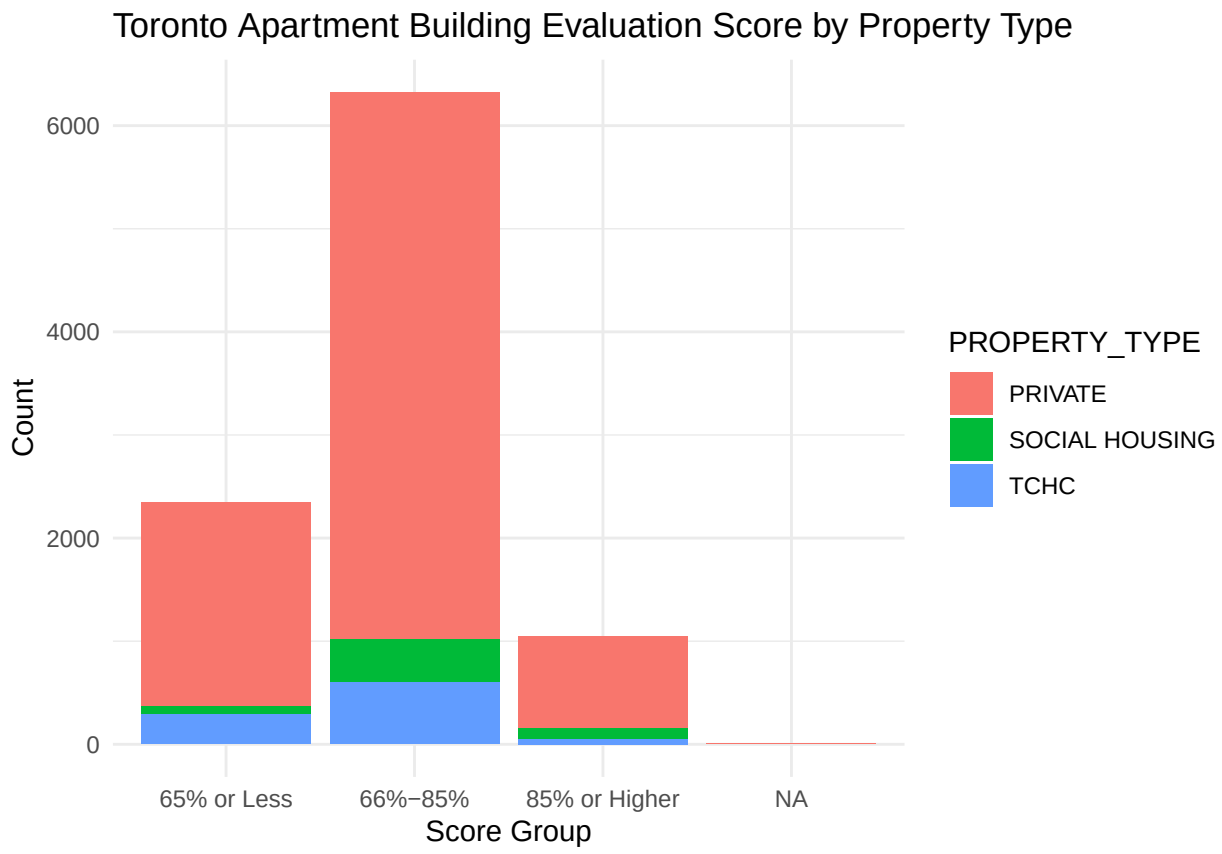

Figure 1: Toronto Apartment Building Evaluation Score Distribution by Property Type

To examine whether different property type would lead to biased evaluation, Figure 1 is generated to demonstrate the proportion of each property type under each score group. The main priority of Social Housing is to be more affordable than private renting(Paul 2021). So, the benefits of renting from a housing association or council usually forms a stereotype that the building environment would be relatively worse than private property. However, combining the observations from Table 2, the average score of social housings does not appear to be significantly lower than private buildings. Instead, only the apartment buildings provided by TCHC would need improvements in building safety.

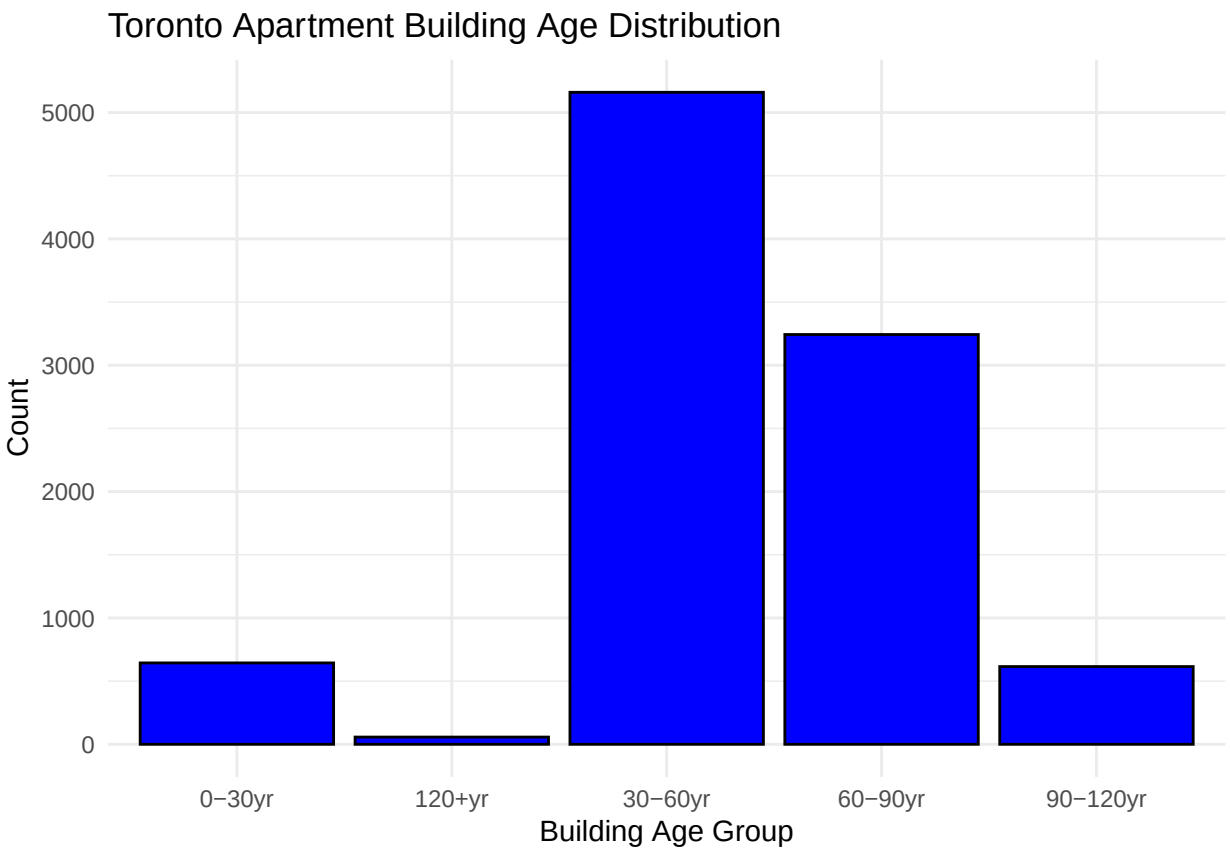

Figure 2: Toronto Apartment Building Age Distribution

To further analyze the building age problem, Figure 2 is created to present the age distribution of the buildings. It shows that the majority of the buildings has been 30-90 years old which could face severe risks of constructure deterioration. The significant proportion of aged buildings in Toronto could derive from the rapid urbanization. However, we could see from Table 2 that none of the evaluated item is associated with the risk of aging.

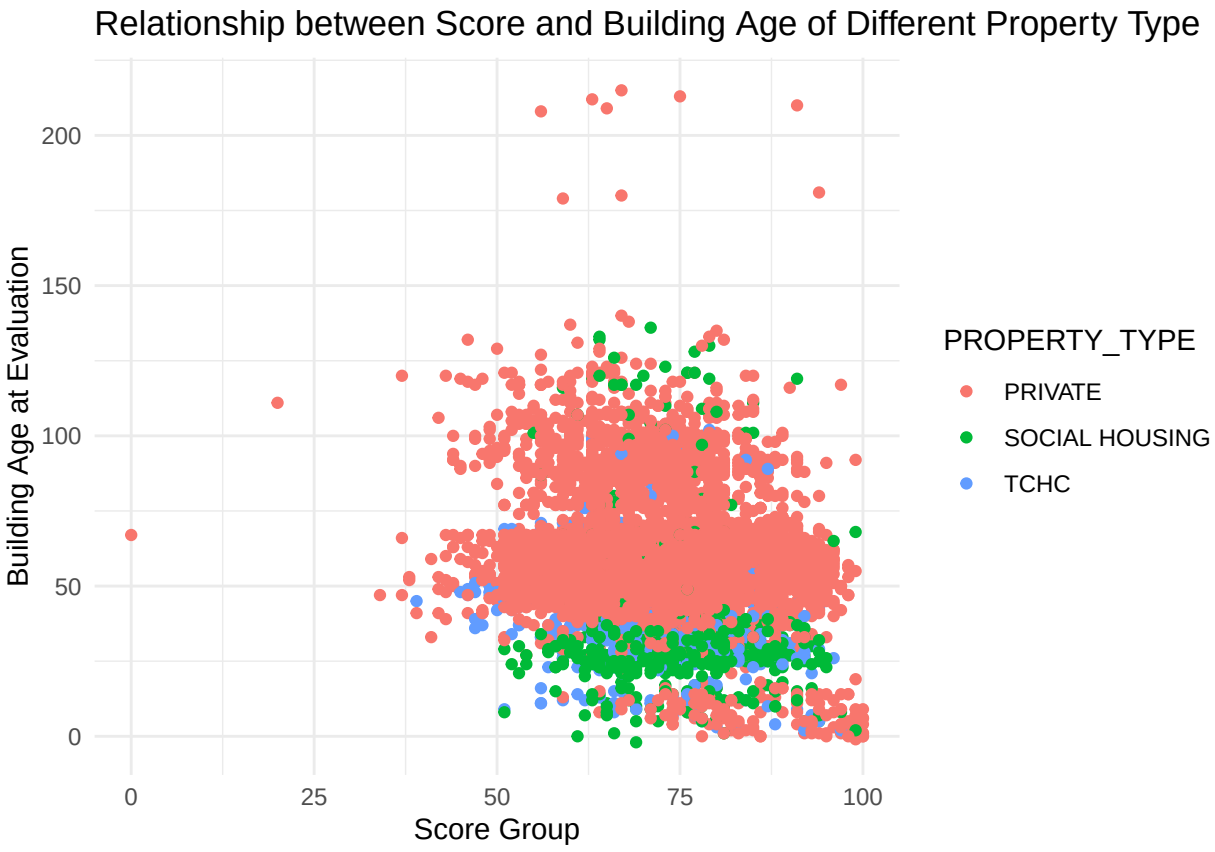

Figure 3: Scatterplot for Relationship between Score and Building Age at Evaluation of Different Property Type

Referring to Figure 3, most private buildings has aged over 50 years while most social housing are built less than 50 years. Combining with Table 2, it implies that there could be a potential negative relationship between safety evaluation score and building age. As mentioned above, the average score of social housing is even relatively higher than that of private properties. To further investigate the relationship, we would perform a Simple Linear Regression to see if this could explain a significant portion of relationship between safety score and building age. The dependent variable in this case would be the evaluation score, and the independent variable is our building age.

Figure 4 demonstrate the scatterplot of the relation between evaluation score and building age with a fitted regression line. The fitted regression line is downward sloping implying that the relation between safety score and building age should be negative as we expected. However, we could see that the fitted regression line does not has a large absolute value of slope which means that the relation is not very strong. On the other hand, even though the fitted regression line does not appear to be very steep, building age should still be considered as an essential part when evaluating building safety.

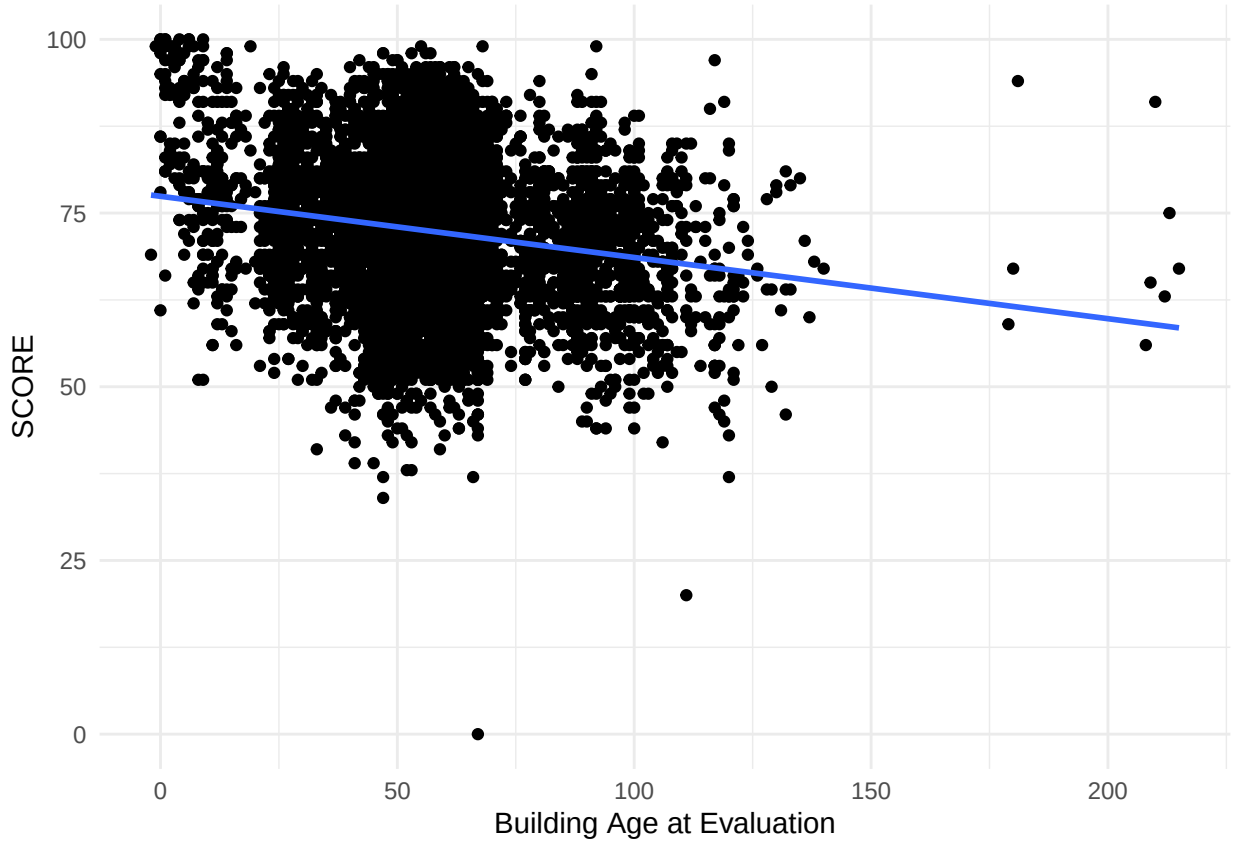

Figure 4: Scatterplot with Fitted Regression Line of Score Building Age

3 Limitations and Conclusion

Reference

Arel-Bundock, Vincent. 2022. *Modelsummary: Summary Tables and Plots for Statistical Models and Data: Beautiful, Customizable, and Publication-Ready*. https://CRAN.R-project.org/package=modelsummary.

Blair, Graeme, Jasper Cooper, Alexander Coppock, Macartan Humphreys, and Luke Sonnet. 2022. *Estimatr: Fast Estimators for Design-Based Inference*. https://CRAN.R-project.org/package=estimatr.

Council, National Research. 1991. *Uses of Risk Analysis to Achieve Balanced Safety in Building Design and Operations*. Edited by Bruce D. McDowell and Andrew C. Lemer. Washington, DC: The National Academies Press. https://doi.org/10.17226/1907.

Gelfand, Sharla. 2020. *Opendatatoronto: Access the City of Toronto Open Data Portal*. https://CRAN.R-project.org/package=opendatatoronto.

Jin Ban, Feng Chen, Longzhu Chen. 2020. "Evaluation of the Factors Influencing the Housing Safety Awareness of Residents in Shanghai." https://doi.org/10.1371/journal.pone.0227871.

Paul. 2021. "Social Housing Vs Private Renting, What Should i Choose?" https://movingsoon.co.uk/blog/social-housing-vs-private-renting-what-should-i-choose/.

R Core Team. 2020. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Standards, Municipal Licensing &. 2022. "Apartment Building Evaluation." https://open.toronto.ca/dataset/apartment-building-evaluation/.

Toronto 1998 - 2022, City of. 2022. "RentSafeTO: Apartment Building Standards." https://www.toronto.ca/community-people/housing-shelter/rental-housing-tenant-information/rental-housing-standards/apartment-building-standards/rentsafeto-for-tenants/.

Wickham, Hadley. 2016. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. https://ggplot2.tidyverse.org.

Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D'Agostino McGowan, Romain François, Garrett Grolemund, et al. 2019. "Welcome to the tidyverse." *Journal of Open Source Software* 4 (43): 1686. https://doi.org/10.21105/joss.01686.

Wickham, Hadley, Romain François, Lionel Henry, and Kirill Müller. 2021. *Dplyr: A Grammar of Data Manipulation*. https://CRAN.R-project.org/package=dplyr.

Zhu, Hao. 2021. *kableExtra: Construct Complex Table with 'Kable' and Pipe Syntax*. https://CRAN.R-project.org/package=kableExtra.